Customer No.: 31561
Application No.: 10/064,699
Docket No.: 9148-US-PA

REMARKS

Present Status of the Application

The Office Action rejected all presently-pending claims 1-13. Specifically, the Office Action rejected claims 1-13 under 35 U.S.C. 103(a), as being anticipated by Yoshikawa et al. (U.S. 5,902,129) in view of Wieczorek et al. (U.S. 6,271,122). Claims 1-13 remain pending in the present application, and reconsideration of those claims is respectfully requested.

Discussion of Office Action Rejections

The Office Action rejected claims 1-13 under 35 U.S.C. 103(a), as being anticipated by Yoshikawa et al. (U.S. 5,902,129) in view of Wieczorek et al. (U.S. 6,271,122).

Applicants respectfully assert that Yoshikawa et al. in view of Wieczorek et al.is legally deficient for the purpose of rendering claims 1 and 8 unpatentable for at least the reason that not every element of the claim was taught or suggested by cited references such that the invention as a whole would have been obvious to one of ordinary skill in the art.

The present invention is directed to a cobalt-salicide contact fabrication technique. The cobalt-salicide contact is formed in a contact opening. As the ULSI process advances to 0.18 microns and below, the aspect ratio of the contact becomes even higher. The aspect ratio of the contact opening can be, for example, greater than 10. Therefore, materials filling into the contact opening with high aspect ratio must have enough step coverage to cover the bottom of the contact opening. In the present invention, since the titanium layer covering the cobalt layer

is formed by an ***ionized metal plasma process***, the step coverage of the deposited IMP titanium layer is good, about 50%. The cobalt layer is thus prevented from being contaminated by the impurities in the CVD TiN layer. On the other hand, the present invention also provides forming a silicon nitride spacer ***on the sidewall of the contact*** in order to prevent charge loss due to mobile ions on the sidewall of the contact.

The features are recited in claims 1, and 8.

With respect to claim 1, independent claim 1 recites the features as follows:

1. A fabrication method for a cobalt-salicide contact, comprising:
forming a dielectric layer on a silicon substrate;
forming a contact opening in the dielectric layer, wherein the opening exposes the silicon substrate;
forming a silicon nitride spacer on a sidewall of the contact opening;
forming a cobalt layer at a bottom of the contact opening;
forming an ionized metal plasma titanium layer on the cobalt layer;
forming a chemical vapor deposited titanium nitride layer on the ionized metal plasma titanium layer;
performing a first rapid thermal process to induce a reaction between the cobalt layer and the silicon substrate to form a cobalt-salicide layer;
performing a wet etching to remove an unreacted cobalt layer, the ionized metal plasma titanium layer, the chemical vapor deposited titanium nitride layer;
performing a second rapid thermal process; and
filling the contact opening with a conductive layer.

8. A fabrication method for a cobalt-salicide contact, comprising:
forming a dielectric layer on a silicon substrate;
forming a contact opening in the dielectric layer, wherein an aspect ratio of the contact opening is greater than 10;
forming a silicon nitride spacer on a sidewall of the contact opening;
forming a cobalt layer at a bottom of the contact opening;
forming an ionized metal plasma titanium layer on the cobalt layer;
forming a chemical vapor deposited titanium nitride layer on the ionized metal plasma titanium layer;
performing a rapid thermal process to induce a reaction between the cobalt layer and the silicon substrate to form a cobalt-salicide layer;
filling the contact opening with a conductive layer; and

performing a chemical mechanical polishing process to removed portions of the conductive layer, the ionized metal plasma titanium layer, the chemical vapor deposited titanium nitride layer and the cobalt layer outside the contact opening.
(emphasis added).

Yoshikawa et al. discloses forming a cobalt-salicide on the source/drain and gate electrode, rather than in a contact opening. Further, Yoshikawa et al. disclose the titanium layer covering the cobalt layer is formed by a ***sputtering process*** and do not disclose using a ionized metal plasma process, referring to col. 4, line 34-37. ***The sputtering process is different from the ionized metal plasma and the step overage of the sputtering titanium layer is poor known by those skilled in the art.*** Thus, when the sputtering titanium layer used for forming a contact, the cobalt layer at the bottom of the contact opening can not covered completely by the sputtering titanium layer even if the parameter is optimized. In other words, the step coverage of the sputtering titanium layer can not achieve 50%. Conventionally, the cobalt layer is affected by oxygen gas and nitrogen gas used in the process. Therefore, Yoshikawa et al. fails to teach or disclose the claimed invention. Further, Yoshikawa et al. lack any suggestion that the reference should be modified in a manner required to meet the claims.

On the other hand, Yoshikawa et al. and Wieczorek et al. disclose forming a spacer ***on the sidewall of the gate electrode***, rather than on the sidewall of the contact opening. Moreover, Yoshikawa et al. and Wieczorek et al. lack any suggestion that the reference should be modified in a manner required to meet the claims. Thus, charge loss due to mobile ions on the sidewall of the contact can not avoided.

Even Wieczorek et al. teaches the metal silicon layer is formed in a contact opening, the combination of Yoshikawa et al. and Wieczorek still fails to teach or suggest the claimed features of the present invention. Applicants therefore respectfully submit that Yoshikawa et al. in view of Wieczorek et al. does not render the present invention of claims 1 and 8 unpatentable.

Dependent claims 2-7 and 9-13 are submitted to be patentably distinguishable over the prior art of record for at least the same reasons as independent claims 1 and 8 from which these claims respectively depend, as well as for the additional features that these claims recite. Accordingly, Applicants request that the Section 103 (a) rejection to claims 1-13 be withdrawn.

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CONCLUSION

For at least the foregoing reasons, it is believed that the pending claims 1-13 are in proper condition for allowance. If the Examiner believes that a telephone conference would expedite the examination of the above-identified patent application, the Examiner is invited to call the undersigned.

Respectfully submitted,

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